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(54) Rotary printing press

(57) A rotary printing press eg for multi-colour use omits the customary gearing for ensuring print registration between the plate cylinder (2) and the impression cylinder (1). Instead a microprocessor controlled control unit (20) for separate motors (9 and 6) driving the plate cylinder (2) and impression cylinder (1) maintains print registration during the operation of the press. This allows the plate cylinders to be rapidly brought onto impression because the control unit (20) will maintain registration despite separation of the plate cylinder (2) from the impression cylinder (1), and also allows each of the various plate cylinders (2) of a multi-colour press to be brought onto impression simultaneously when appropriate plate cylinder-moving means (14, 16) are provided.

An optional facility provides for the printing plate to occupy only a portion of the cylindrical surface of the plate cylinder and for the angular velocity of the plate cylinder to be varied when there is no contact between the plate and copy medium at the printing nip (for the purpose of changing repeat length between successive print regions).

Fig.1.

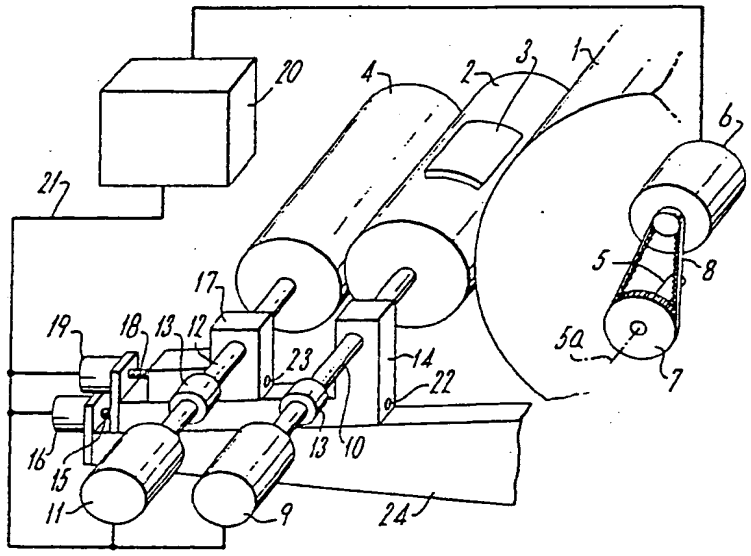

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Fig.1.

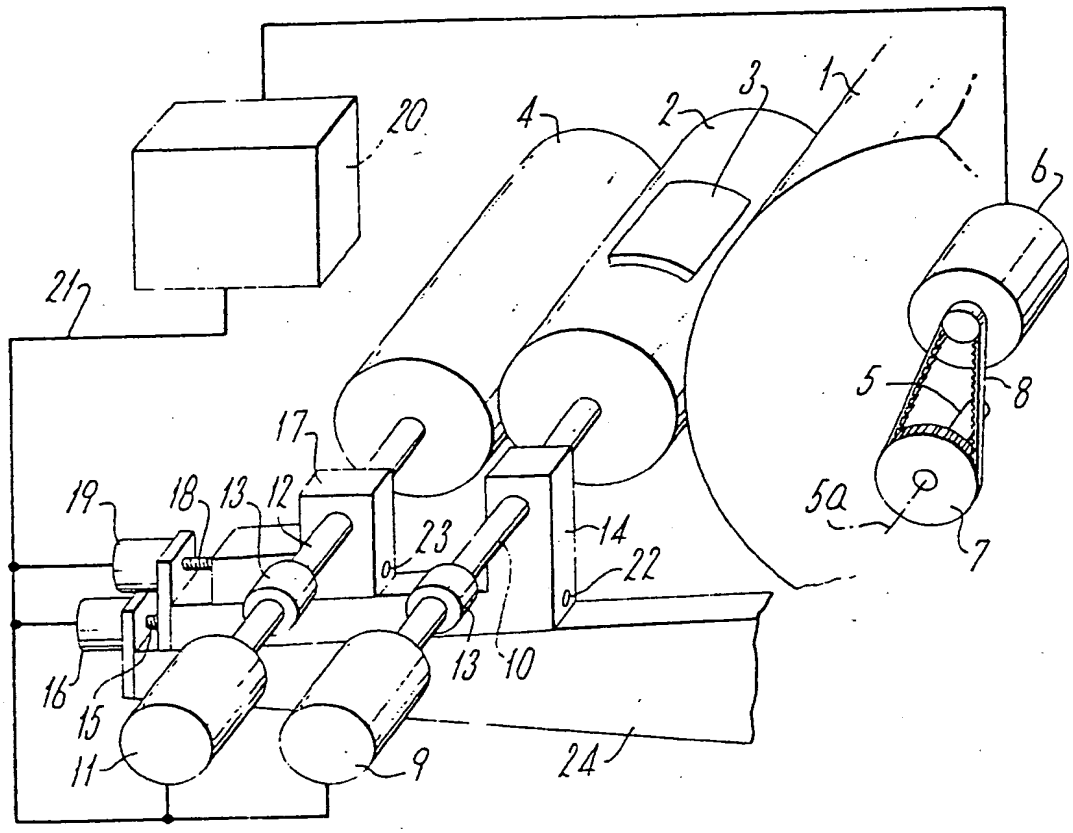

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Fig.2.

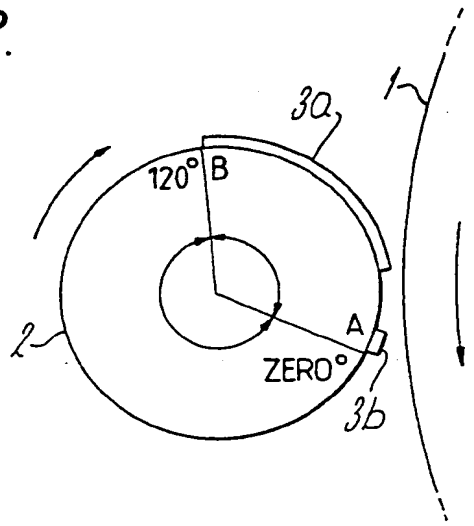
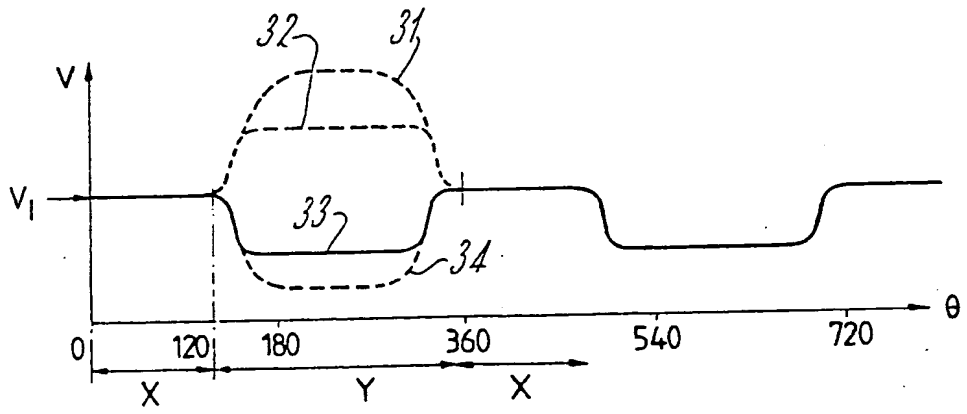


Fig.3.



SPECIFICATION

Rotary printing press

The present invention relates to a rotary printing press, and in particular to the registration of the rollers of such a press.

It is known that a printing press will only give good results if there is accurate registration of positions of the printing master or plate and the medium being printed on. In various types of printing press there are other components which also need to be maintained in accurate registration with the printing master, for example the blanket in a rotary printing press.

Hitherto a rotary printing press has required accurate gearing to enable the roller registration to be maintained once it has been set, and there has also been a limit on the degree of accuracy with which the print register can be adjusted because the minimum incremental change of registration is tied to the pitch of the gearing between the carrier for the printing master, normally the plate cylinder, and the carrier for the medium being printed, normally an impression cylinder. A subsidiary problem arising from this situation is that the thickness of the printing plate and/or any "make ready" or "backing sheet" which is applied to the plate cylinder underneath the plate must be accurately controlled because of the inability to compensate for small variations in the radial spacing of the plate surface from the axis of rotation of the plate cylinder to a degree of accuracy any finer than one tooth pitch of the gearing. Hitherto the task of setting up a printing plate for accurate registration of printing has required the accurate establishment of this radial spacing of the plate surface from the plate cylinder, in order that the surface speeds of the printing plate and of the medium being printed carried on the impression cylinder can be correct for maintained print registration. For effective printing, not only must certain of the rolling surfaces always contact each other with the same parts, but also the contact between all rolling surfaces should be a "scrub-free" pure rolling contact.

Accordingly one aspect of the invention provides a rotary printing press comprising a plate cylinder and a rotary support for a material to be printed, a first motor driving said plate cylinder, and a second motor driving said support for the material to be printed and control means for ensuring accurate control of the mutual rotational positioning of said first and second motors to ensure positional synchronisation of a plate on said plate cylinder with respect to said rotary support without the need for any mechanical interconnection between the plate cylinder and the support.

The problems mentioned above are much more acute when the printing press is a multi-colour press and it is necessary for very accurate registration of several different plate cylinders, each bearing a different colour, with respect to the image being printed by the other plates.

A second aspect of the present invention provides a rotary printing press including a rotary support for material to be printed, a plate cylinder adapted to support a plate over a part of its cylindrical surface for rolling contact at an image-transferring nip, a first motor for driving said plate cylinder, a second motor for driving said rotary support, and control means for controlling the position of said plate cylinder with respect to said rotary support, wherein said control means is effective to maintain positional relationship at a constant surface speed of said plate cylinder over a first sector of rotation of the plate cylinder, and to vary the speed of said plate cylinder over a second sector of rotation of said plate cylinder for changing the time delay between the end of the first sector of one revolution of the plate cylinder and the start of said first sector in the next successive revolution of the plate cylinder.

In order that the present invention may more readily be understood the following description is given, merely by way of example, with reference to the accompanying drawings in which:–

Figure 1 is a perspective schematic view of one inking unit and plate cylinder assembly of a multi-colour press whose impression cylinder is also shown in this drawing, the press being in accordance with the present invention;

Figure 2 is a side elevational view showing a detail of the printing cylinder and the adjacent plate cylinder, and illustrating an alternative embodiment of the present invention; and

Figure 3 is a plot of the peripheral speed of the printing plate against the angular position of the plate, and is applicable to the embodiment of Fig. 2.

Referring now to Fig. 1, there will be seen an impression cylinder 1 which carries a continuous web of material to be printed, for example a continuous web of plastics packaging material (not shown).

The continuous plastics web is to be printed in at least two colours and the drawing shows the plate cylinder 2 carrying a plate 3 applicable for one of these colours. The drawing also shows the inking roller 4, preferably an anilox roller, which applies ink to the plate 3.

In a conventional rotary printing press, the plate cylinder 2 would be mechanically geared to the main shaft 5 of the impression cylinder (rotatable about the rotation axis 5*a* in Fig. 1) and the anilox inking roller 4 would in turn be mechanically geared to the plate cylinder 2 for scrub free contact between the finely profiled anilox roller 4 and the resilient flexographic printing plate 3. The arrangement is such that

the plate cylinder 2 can be withdrawn from contact with the impression cylinder 1 for the purpose of changing over plate cylinders or otherwise gaining access to components of the press, and the anilox inking roller 4 is in turn separable from the plate cylinder 2, for example for purposes of stopping the supply of ink to the plate 3 during operation or during the process of plate changing while setting up the machine for printing. This separability of the plate cylinder 2 from the impression cylinder 1 and of the inking roller 4 from the plate cylinder 2 is still possible with the present invention.

However, instead of the customary gearing between the impression cylinder 1, on the one hand, and the inking roller 4, on the other hand, the rotary press in accordance with the present invention provides for three separate accurately controlled drive motors to be coupled to the respective rotary components.

Thus the impression cylinder 1 is rotated by its electric drive motor 6 drivingly engageable with a toothed pulley 7 on the impression cylinder drive shaft 5 by way of a toothed belt 8. The plate cylinder 2 is in this case directly driven by its own digitally controlled electric motor 9 on the end of the plate cylinder drive shaft 10, and likewise the inking roller 4 is driven by its own digitally controlled electric motor 11 on the inking roller drive shaft 12.

In order to allow for easy removal and replacement of the plate cylinder 2 and of the inking roller 4, quick-release mechanical couplings 13 are in this case provided on the drive shafts 10 and 12 alongside the drive motors 9 and 11.

At the end of the plate cylinder drive shaft 10 is a respective decking carrier 14 which is driven towards and away from the rotation axis 5*a* of the impression cylinder 1 by means of a lead screw 15 rotated by a stepper motor 16.

Similarly, at each end of the inking roller drive shaft 12 is a respective decking carrier 17 driven towards and away from the axis of rotation of the plate cylinder drive shaft 10 by means of a lead screw 18 driven by a stepper motor 19.

The improvement in accordance with the present invention requires a master controller, in this case schematically illustrated as a control unit 20, to control the speed of rotation and the rotational position of the motors 9 and 11 with respect to the speed of rotation and the rotational position of the impression cylinder 1 (in this case by reference to the angular position and speed of its drive motor 6). The control unit 20 also controls the operation of the "decking" stepper motors 16 and 19. The control connections between the control unit 20 and the various motors 6, 9, 11, 16 and 19 are schematically illustrated at 21 on Fig. 1.

Each of the drive motors 6, 9 and 11 is associated with an encoder or "position resolver" which provides an accurate indication of the rotational position of the motor shaft and generates pulses to be applied to the control unit 20 to enable the control unit 20 to ensure accurate registration of mutual positioning of the impression cylinder 1, the plate cylinder 2 and the anilox inking roller 4.

A feedback of the position of the decking carriers 14 for the plate cylinder 2 and of the carriers 17 for the inking roller 4 is achieved by way of a proximity detecting system 22 for the plate cylinder decking carrier 14 and a further proximity detecting system 23 for the inking roller decking carrier 17. The proximity sensor 23 for the ink roller decking carrier 17 senses when the carrier 17 arrives adjacent the upstanding part of the plate cylinder decking carrier 14, and the proximity sensor 22 for the plate cylinder decking carrier 14 senses when the carrier 14 arrives adjacent an upstanding part (not shown) of the machine frame 24.

The control unit 20 preferably includes a microprocessor enabling the positions of the three motors 6, 9 and 11 to be established and maintained accurately, and also allowing variation in the rotational position relationship in response to a "print advance" or "print retard" control inputs given by the operator.

The microprocessor also enables the "decking" stepper motors 16 and 19 to be activated separately for so-called "decking" movement of the plate cylinder deck defined by the carriers 14 and the inking roller deck defined by the carriers 17.

Such position-responsive and -maintaining control systems are well known in the art and since the detailed circuitry does not form a part of the present invention we draw attention to U.S. Patent Specifications Nos. 4,090,116, 4,099,107, 4,344,127 and 4,357,561 as examples of disclosures using similar circuitry for accurately controlling the position of movable elements.

Reference is also made, for the sake of completeness, to U.S. Patents Nos. 4,377,847, 4,277,191 and 4,114,750 showing the use of electronic position control in printing systems.

The surprising characteristic of the present invention is that it is possible to achieve and to maintain accurate positioning of the rotating components of the press, in this case the impression cylinder 1, the plate cylinder 2 and the ink applying means represented by the anilox inking roller 4, merely by use of an electronic control unit 20 for the motors 6, 9 and 11 driving these various rotary components. The cost of supplying the conventional gearing of a quality high enough to resist rapid wear during use of the press, and the time loss needed in order to establish accurate registration of the plate cylinder 2 with respect to the impression cylinder 1 as the plate

cylinder is brought back onto impression, and possibly also to change the gearing ratio when a plate cylinder having a different radial dimension is installed, is saved by the control unit 20 and the duplicated drive motors 9 and 11 for the plate cylinder 2 and inking roller 4.

By virtue of the accurate position-synchronisation of the plate cylinder 2 and of the inking roller 4 with respect to the impression cylinder 1 it is possible, after removal of the plate cylinder 2 from its impression position, to restore that plate cylinder on impression without the need for re-registration of the print because the necessary registration is maintained by virtue of the control unit 20, and to know that scrub-free rolling contact of the finely profiled ink-bearing anilox inking roller 4 with the elastomeric flexographic printing plate 3 on the plate cylinder is ensured.

The use of separate stepper motors 16 and 19, controlled by the control unit 20, for decking the ink roller 4 and plate cylinder 2 means that it is then possible for the control unit 20 to signal simultaneous decking of all of the ink units and plate cylinders of a multicolour printing press with respect to the common impression cylinder 1 so that all of the colours come back on impression simultaneously. This considerably reduces the time spent in the decking operation as compared with manual decking which requires the operator to position each plate cylinder carefully at the correct spacing from the axis of rotation 5*a* of the impression cylinder and with the correct angular alignment (by registering the teeth of the gearing of a conventional press).

Furthermore, it is well within the ability of the designer of the control unit 20 to provide for "on-the-run" registration of print so that it is possible to bring each of the plate cylinders back into engagement with the medium being printed, by substantially simultaneously redecking of all the colours, and subsequently to adjust the positions of individual plate cylinders 2 to establish accurate registration. To ensure "scrub-free" rolling contact of the inking roller 4 with the plate 3 during any such "on-the-run" print registration adjustment the control unit 20 will have to be capable of changing the rotational position of the inking roller in response to the position changes of the plate cylinder (in proportion to the diameters of the inking roller 4 and plate cylinder 2).

Print registration may also be ensured by setting the cylinders 1 and 2 manually while stationary and (if necessary) adjusting the control unit 20 before restarting the press, to make sure that when rotation of the cylinders 1 and 2 resumes the mutual rotational positioning of the cylinders 1 and 2 will give pure rolling contact at their peripheries with correct print registration.

Another advantage of the system in accordance with the present invention is that there is no longer the previous limit on the smallest incremental change of repeat length registration. Whereas previously the mechanical constraints of the gear tooth pitch prevented fine adjustment of repeat lengths (to enable the printing plate to be packed out to a larger diameter and hence a larger circumference), provided the number of pulses generated per revolution of each of the motors 6, 9 and 11 is high enough there is virtually infinitely variable adjustment facility requiring a simple change of the mulitplication ratio of the relationship of the pulses from the various motors, by the operator effecting a suitable input signal to the control unit 20.

Fine adjustment of print is also facilitated because whereas fine adjustment (to an accuracy of less than one tooth pitch) previously involved axially repositioning the helical gears driving the plate cylinder, it is now possible to make such an adjustment merely by temporarily changing the speed of the plate cylinder to reposition it relative to the impression cylinder by the required increment.

Further advantages of the system in accordance with the present invention are that:—
(a) the replacement of a plate cylinder is now much quicker because previously the plate cylinder needed to be fitted with the gear which is common to all available plate cylinders of a given size and was attached (to the plate cylinder being fitted) before the plate cylinder is installed in the press; (b) the time taken to clean down the machine (for example for ink colour changes) will be shorter because there is no longer any need to clean the gearing and to ensure re-registration of the gearing when the plate cylinder is brought back onto impression; (c) the serious problem of providing machine guards on the gearing is eliminated; (d) changing the printing plate and the backing sheet thicknesses on the plate cylinder is more straightforward because the small resulting variations of diameter of the plate/plate cylinder combination can be corrected for in the much finer speed ratio adjustment possible with the electronic control unit 20; and (e) the incidence of "chatter-marks" in the print caused by resonance of the gearing, and also the general vibration level in the press are reduced. The elimination of this gear vibration will additionally reduce bearing wear and also wear in the other associated components of the machine which effect positioning and movement of the plate cylinders and/or ink rollers.

The much finer adjustment facility allows the operator to be able to compensate for very small changes in plate cylinder diameter, for example after re-grinding of a plate cylinder, so that the working life of any given plate cylinder can be considerably extended by use with the press in accordance with the present invention.

Fig. 2 shows the function of an optional

facility available in the press of Fig. 1, provided the control unit 20 is of the appropriate type.

The above description has assumed everywhere that the speed of rotation of the plate cylinder 1 will be substantially uniform throughout each cycle, subject to the ability of the control unit 20 to maintain and/or restore registration by small changes in the speed of rotation of the plate cylinder 2 and the inking roller 4.

With the optional feature illustrated in Fig. 2, the positional relationship of the plate cylinder 2 with respect to the impression cylinder 1 needs to be maintained only during rolling of a sector AB of the plate cylinder past the printing nip. During this rolling action there will first of all be contact of a first plate or a first plate area 3*a* to print a main design on the medium being printed, and then there will be a gap corresponding to the sector BA before a subsidiary plate or plate area 3*b* prints a small panel at the end of the medium being printed (for example a "Registered Trade Mark" panel at the bottom of a bag, or an optical film registration mark for subsequent detection by a photo-electric transducer, where the medium being printed is a continuous web of plastics packaging material, e.g. a chain of plastics packaging bags).

While printing of the main panel from the plate or plate area 3*a* and printing of the subsidiary panel from the subsidiary plate or plate 3*b* is taking place there must be accurate registration of the position of the plate cylinder 2 with the medium being printed, and of course in the case of a multi-colour press there must be accurate registration of the other plate cylinders in use with the medium being printed. However, while the sector BA is rolling past the printing nip there is no printing being carried out and the absence of a relief printing plate region over that sector BA makes it possible for the speed of the plate cylinder 2 to be varied if desired.

This possibility of speed variation is particularly useful because it allows the repeat length (i.e. the spacing on the printed material between two successive images of any part of the plate or plate portion 3*a* or 3*b*, and hence the spacing between the main panel printed by plate or plate portion 3*a* and the subsidiary panel printed by plate or plate portion 3*b*) to be varied by either increasing the rotation rate of the plate cylinder 2 over the sector BA in order to reduce the repeat length or by reducing the plate cylinder rotation rate over the sector BA in order to increase the repeat length. The rotation rates must, however, be synchronised accurately when sector AB is in the nip.

The optional repeat length variation facility illustrated in Fig. 2 therefore requires the control unit 20 to be capable of maintaining accurate position synchronization of the plate cylinder 2 during rolling of the sector AB (hereinafter called the "constant speed sector") past the printing nip and allows an increase or a decrease in the speed of rotation of the plate cylinder 2 as the sector BA (hereinafter called the "variable speed sector") rolls past the printing nip, subject to restoration of accurate positional registration at the end of the variable speed sector in order that the subsidiary panel may be correctly printed on the packaging material.

Fig. 3 illustrates the possibilities of variation of repeat-length in order to achieve the desired results. The curve 31 shows a shortest repeat length, the curve 32 shows a somewhat longer repeat length, the curve 33 shows an even longer repeat length, and the curve 44 shows the longest of the four repeat lengths depicted in Fig. 3. The ordinate represents press surface speed and the abscissa represents angular position of the plate cylinder.

The rolling of the various constant speed sectors past the printing nip is represented by intervals X on the abscissa, and rolling of the various variable speed sectors is represented by the intervals Y on the abscissa. Clearly, the time duration of each interval X is constant but the time duration for the intervals Y will vary depending upon which particular speed envelope 31, 32, 33, 34 or other envelope available, is used. Bearing in mind that the material being printed is expected to be in continuous web form and is travelling at speed V_1 which is equivalent to the surface speed of the printing plate 3*a*, 3*b* over the constant speed sector, the repeat length of the material (e.g. the length of film which travels past the printing nip during the time duration of the "variable speed sector" Y) will change according to the particular speed envelope chosen for the variable speed sector.

Whereas in a conventional printing press the variation of the repeat length such as the repeat length and possibly also the spacing of each image of the above-mentioned main panel and the next successive image of the subsidiary panel would have necessitated removal of one plate cylinder and replacement by another plate cylinder having a different diameter so that the constant speed operation of the plate cylinder would nevertheless allow for a change of the repeat length, the press described above with reference to Figs. 2 and 3 avoids the need for such plate cylinder change (involving a time penalty of several tens of minutes) and allows the repeat length to be altered by the operator at the flick of a switch.

The optional facility illustrated in Fig. 2 can also be useful where instead of having two plates or plate regions 3*a*, 3*b*, there is a continuous plate over the "constant speed sector" and the repeat length between one image printed by that plate and the next

image printed by that plate is to be changed.

From the above it will be understood that the press in accordance with the present invention provides a particularly advantageous result with regard to printing of packaging material, but nevertheless the facility for electronically varying the print registration in a monochrome press or in a multi-colour press for any other application provides a considerable improvement over the conventional directly geared systems providing much more limited print registration.

A particularly convenient possibility for the press of the present invention is that whereas hitherto there has been a need for a press to be capable of using, and indeed to be supplied together with, a set of many different plate cylinders of different diameters for changing the repeat lengths, a press in accordance with the present invention (having the "variable speed sector" facility) may simply be supplied with a single set of large diameter plate cylinders (one per colour) in the knowledge that shorter repeat lengths may be obtained by using a speed envelope such as 31 or 32 (Fig. 3) without the need for a plate cylinder change. Indeed with the so-called foil "plate carrier" system of plate mounting (in which a plate of any size is attached to a sheet of carrier foil of a length exactly equal to the circumference of the plate cylinder so the foil can readily be attached to the plate cylinder to mount the flexographic plate on the cylinder 2) there will be no need for plate cylinder "decking" movement or for inking roller "decking" movement. Thus much simplified presses having fixed axis plate cylinders and inking rollers are possible. The carrier foil for the plate may, for example, be very simple attached to the plate cylinder by use of some clamping or pinning system to ensure correct positioning of the plate relative to the transverse reference axis or datum line of the plate cylinder.

Although, in the above description, the decking motors 16 and 19 are described as stepper motors it is of course possible for any type of servo motor to be used instead of a stepper motor.

Another possible variant is for the inking roller motor 11 to be controlled in response to the main drive motor 6 of the impression cylinder 1 to a sufficiently high degree of accuracy to maintain pure rolling contact of the plate cylinder 2 and inking roller 4, rather than slaving the inking roller motor 11 directly to the plate cylinder motor 9, as described herein.

CLAIMS

1. A rotary printing press comprising a plate cylinder and a rotary support for a material to be printed, a first motor driving said plate cylinder, and a second motor driving said support for the material to be printed and control means for ensuring accurate control of the mutual rotational positioning of said first and second motors to ensure positional synchronisation of a plate on said plate cylinder with respect to said rotary support without the need for any mechanical interconnection between the plate cylinder and the support.

2. A rotary press according to claim 1, wherein said rotary support is an impression cylinder and the plate cylinder is arranged to form a printing nip between a plate on the plate cylinder and a medium passing over said impression cylinder.

3. A rotary press according to claim 2, and including an ink roller arranged to be in rolling contact with a plate on said plate cylinder and driven by a third motor, said control means being effective to maintain rolling contact of the inking roller and plate cylinder by control of the position of said inking roller in relation to the position of said impression cylinder or plate cylinder.

4. A rotary printing press according to any one of the preceding claims, and including means for moving the or each said plate cylinder into impression-forming position in relation to the rotary support, said plate cylinder moving means being controlled by said control means.

5. A rotary printing press according to claim 4 when appendant to claim 3, and including means for moving said ink roller into contacting relationship with a plate on said plate cylinder, said ink roller moving means being under the control of said control unit.

6. A rotary printing press according to claim 2, 3 or 5, or to claim 4 when appendant to claim 2 or 3, wherein the press is a multi-colour press and includes at least two plate cylinders each for carrying a plate for printing a different colour from that of the or each other said plate cylinder, each said plate cylinder having its own respective first motor, and said control means being effective to control the position of each of said plate cylinders with respect to said impression cylinder with which each of them forms a respective printing nip.

7. A rotary printing press including a rotary support for material to be printed, a plate cylinder adapted to support a plate over a part of its cylindrical surface for rolling contact at an image-transferring nip, a first motor for driving said plate cylinder, a second motor for driving said rotary support, and control means for controlling the position of said plate cylinder with respect to said rotary support, wherein said control means is effective to maintain positional relationship at a constant surface speed of said plate cylinder over a first sector of rotation of the plate cylinder, and to vary the speed of said plate cylinder over a second sector of rotation of said plate cylinder for changing the time delay between the end

of the first sector of one revolution of the plate cylinder and the start of said first sector in the next successive revolution of the plate cylinder.

8. A multi-colour rotary printing press according to claim 7, wherein there are several said plate cylinders and said control unit is effective to control the position of, and to vary the rotation rate of, each of said plate cylinders in relation to the movement of a common said rotary support.

9. A multi-colour rotary printing press according to claim 8, wherein said rotary support is an impression cylinder and each of said plate cylinders forms a respective printing nip with said impression cylinder.

10. A rotary printing press substantially as hereinbefore described with reference to, and as illustrated in, Fig. 1 of the accompanying drawings.

11. A rotary printing press according to claim 10 and modified substantially as hereinbefore described with reference to Figs. 2 and 3 of the accompanying drawings.

12. Plastics packaging material printed by a printing press according to any one of the preceding claims.

13. A web of plastics packaging material printed by use of the rotary printing press of any one of claims 1 to 12.

CLAIMS

1. A multi-colour rotary printing press comprising a plurality of plate cylinders each of which, in use, carries a respective plate for one of the colours to be printed; a common rotary support for a continuous strip of material to be printed by means of the various plate cylinders; a respective first motor driving each of said plate cylinders; a second motor driving said common rotary support for the material to be printed; and control means for ensuring accurate control of the mutual rotational positioning of each of said first motors with respect to said second motor to ensure continuous positional synchronisation of plates on each of said plate cylinders with respect to said common rotary support over several cycles of the process, there being no mechanical interconnection between the plate cylinders and the common rotary support.

2. A rotary press according to claim 1, wherein said rotary support is an impression cylinder and the plate cylinders are arranged to form a printing nip between a respective plate on each of the plate cylinders and a continuous medium passing over said impression cylinder.

3. A rotary press according to claim 2, and including a respective ink roller arranged to be in rolling contact with a plate on each said plate cylinder and driven by a respective third motor, said control means being effective to maintain rolling contact of the inking rollers and plate cylinders by control of the position of said inking rollers in relation to the position of said impression cylinder or the respective plate cylinder.

4. A rotary printing press according to any one of the preceding claims, and including means for moving each said plate cylinder into impression-forming position in relation to the rotary support, said plate cylinder moving means being controlled by said control means.

5. A rotary printing press according to claim 4 when appendant to claim 3, and including means for moving each of said ink rollers into contacting relationship with a plate on said respective plate cylinder, said ink roller moving means being under the control of said control unit.

6. A rotary printing press according to any one of claims 1 to 5, wherein each said plate cylinder is adapted to support a plate over a part of its cylindrical surface for rolling contact at a respective image-transferring nip, and wherein said control means is effective to maintain continuous positional relationship over several cycles of the process at a constant surface speed of each said plate cylinder over a first sector of rotation of the plate cylinder, and to vary the speed of said plate cylinder over a second sector of rotation of said plate cylinder in each of several indentical cycles for changing the time delay between the end of the first sector of one revolution of the plate cylinder and the start of said first sector in the next successive revolution of the plate cylinder.

7. A rotary printing press substantially as hereinbefore described with reference to, and as illustrated in, Fig. 1 of the accompanying drawings.

8. A rotary printing press according to claim 7 and modified substantially as hereinbefore described with reference to Figs. 2 and 3 of the accompanying drawings.

9. A web of plastics packaging material printed by use of the rotary printing press of any one of claims 1 to 8.

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